tion to the theory of the æther. As regards mathematical calculations, space is saved by expressing results in vector notation, as well as by numerous references to the original memoirs; the treatment of the more important advances, without being exhaustive, is sufficiently adequate to define them clearly in their historical setting, that being the proper function of a work of this type.

Two-thirds of the book are devoted to the period ranging from Descartes to Maxwell. For most students this will probably be the more valuable portion, epitomising work which is not easily accessible.

Dr. Whittaker makes an interesting addition to the history of the law of electrostatic attraction between two charged particles. The law of inverse square of the distance is commonly ascribed to Coulomb, on account of his direct verification by means of the torsion balance (1785). When the researches of the Hon. Henry Cavendish were edited by Maxwell in 1879, it was seen that the same law had been established by a different method as early as 1773; on referring to early literature, such as Young's "Lectures," it appeared that the unpublished work of Cavendish was quite unknown to his contemporaries. Dr. Whittaker directs attention to a still earlier statement in Priestley's "History of Electricity," published in 1767. It appears that Priestley, following Franklin, had made experiments which showed that, when a hollow metallic vessel is electrified, there is no charge on the inner surface, and no electric force in the air inside. Priestley then continues:

"May we not infer from this experiment that the attraction of electricity is subject to the same laws with that of gravitation, and is therefore according to the squares of the distances; since it is easily demonstrated that were the earth in the form of a shell, a body in the inside of it would not be attracted to one side more than another?"

The chapter on elastic solid theories covers an important period. Cauchy, who was first in the field, obtains full credit for his various theories; although one sees how his work failed to stimulate later writers, especially of the English school. Dr. Whittaker remarks that his point of view in the earlier theories appears to have been : Given the equations of vibration of an elastic solid, what boundary conditions must be used in order to obtain Fresnel's results? It was Green who first showed that with a properly localised energy function, the Lagrangian method gave not only the equations of motion, but also the correct boundary conditions.

Some attention is paid to the æther of Cauchy's third theory of reflection, better known as the contractile æther of Lord Kelvin. The form of energy function used by Lord Kelvin might have been noticed; after beginning with the ordinary form for an elastic solid, he transformed it, by integrating by parts, into a form similar to that of MacCullagh's theory. One would consider this form as properly localised, not for the contractile æther, but for a medium specified to be rotationally elastic.

In the later portion of the book mechanical theories are treated further under the more modest description of models of the æther; there are also chapters on

the followers of Maxwell, on conduction in solutions and gases, and on more recent theories of æther and electrons. These give a general account of various lines of advance since the time of Maxwell; in particular one notices the problem of relative motion of the earth and the æther, leading to a consideration of the nature of systems of measurement of space and time. The period of the book closes with the æther still endowed with a certain degree of substantiality, however different it may be from ordinary matter. In view of more recent developments based on the theory of relativity, Dr. Whittaker's treatise appears at an opportune time; it forms an important and valuable aid to a comparative study of theories of the æther.   T. H. H.

DISEASES OF ECONOMIC PLANTS.

Diseases of Economic Plants. By Prof. F. L. Stevens and J. G. Hall. Pp. x+513. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 8s. 6d. net.

THIS book is primarily intended for those who wish to recognise—without having recourse to the microscope—and then to combat fungous diseases of cultivated plants. Descriptions are given of the prominent characteristics of the most destructive diseases of fruit and vegetables cultivated in the United States, as well as information regarding the latest methods of prevention or cure. All the best bulletins of the numerous State agricultural experimental stations and of the U.S. Department of Agriculture have been examined for facts; the authors have had the help also of various specialists in reading over the proofs of certain parts, *e.g.* Dr. Erwin F. Smith has thus assisted with the bacterial diseases, Dr. L. R. Jones with potato diseases, and so forth. Short, clear, scientific descriptions are given of the various life-stages of the species of fungi causing plant diseases; these are accompanied by practical advice as to the methods to be employed against each stage by the grower. In many cases, *e.g.* in that of the onion "smut" and of the "common scab" of the potato, and of the various diseases of the apple, the account given is a model of what should be provided by the man of science for the practical man. Clear directions are given for the making and application of fungicides, and also useful information on the subject of spraying machinery. It would have been well, however, to have supplied fuller information on the subject of "Bordeaux injury," and how it may be avoided. Practical details are given of the disinfection of seeds by the use of formaldehyde gas, and the various methods of soil disinfection are discussed. It is pointed out that the presence in land of such ineradicable soil diseases as the melon, cowpea, cotton, or tobacco "wilt," onion "smut," cabbage "black rot," &c., may result in a depreciation of 50 per cent. or more in the market value of the land. In dealing with many of the diseases of cereals, pea, bean, lettuce, celery, potato, carnation, violet, asparagus, grape, strawberry, and other fruits the authors are not content with merely

stating that "resistant" varieties or "strains" should be grown but in all cases mention the names of such "resistant" varieties obtainable on the market. Such practical information is likely to be of great value to the market grower or gardener; it must be admitted that such assistance as this is not yet able to be given in this country, except in a few cases, by the man of science to the grower.

Throughout the book we find instances given of fungous diseases of different crops which have become epidemic in various districts in the States and caused serious money losses; on the other hand, we have detailed evidence given showing that such losses may often be avoided by careful and thorough spraying with the right fungicide at the right time. The annual loss caused by potato "blight" in the United States is estimated at 36,000,000 dollars; that caused by wheat "rust," 67,000,000 dollars. Turning to horticultural crops, we are told that the violet "leaf-spot" caused, in 1900, a loss of 200,000 dollars; the celery "leaf-spot"—which for the past three seasons has been causing havoc in several counties in this country—is stated to have caused a loss, in California, in 1908, of 1950 car-loads, and a money loss of 550,000 dollars. An interesting account is given of the gradual invasion of the States since 1896 by the asparagus "rust"; it is now known in every State where asparagus is grown—

"In some States the invasion of this disease has almost, if not quite, prohibited commercial asparagus growing. . . . The Palmetto varieties are quite resistant, and offer a solution of the rust problem in some localities."

Of the American gooseberry mildew (which we may remember has, since its introduction into Europe, about 1900, now spread over the whole of Ireland and England) it is said:—

"This disease has quite prohibited the cultivation of the finer sorts of English gooseberries in America, and is a grave menace to the culture of gooseberries in Europe."

One or two points of purely scientific interest may be noted. The statement is made that the pea mildew (*Erysiphe polygoni*) hibernates in seed derived from affected pods, and that the celery "leaf-spot" (*Septoria petroselini*, var. *Apii*) is probably carried by the seed of celery. The mistake is made of identifying the mildew on cucumber, cantaloupes, and muskmelons with *Erysiphe polygoni*, although Reed's interesting work on the specialisation of parasitism shown by this mildew—which this mycologist correctly referred to *E. Cichoracearum*—was recently published in the States. In place of *Podosphaera* the misprint *Podosphaeria* (with the "popular" (!) name "podosphaeriose") appears three times; also the erroneous name of *Sphaerotheca mali* is continued for the apple mildew, and the mistake made of supposing that *Podosphaera leucotricha*—of which *S. mali* is a synonym—is a distinct species.

The book is very well illustrated, and the writing remarkably clear and to the point. There is one touch of pedantry—quite out of place in such a practical book as this—against which a strong protest must be raised—the attempt to create "popular"

names derived from the generic name of the fungus causing the disease. Thus we have "Sphæropsose" proposed for "black rot," caused by *Sphaeropsis,* and such verbal monstrosities as "pseudomonose," "lasiodiplose," "meruliose," &c.

A chapter on the legislative regulations—Federal and inter-State—in force in America might have been added to make the admirable thoroughness of this book quite complete. As it is, this book should be in the hands of all the officials—both the Board of Agriculture's inspectors and the inspectors of the various county councils—who are now engaged in England in the work of combating fungous diseases under the provisions of the "Destructive Insects and Pests Act." The importance of the need to create a more enlightened public opinion on matters connected with plant protection and plant sanitation is rightly insisted upon in this book; as its authors say:—"To create a much-needed, enlightened, aggressive public opinion is part of the duty of plant pathology."

E. S. S.

ELEMENTARY MATHEMATICS.

(1) *A Class Book of Trigonometry.* By Dr. C. Davison. Pp. viii+200. (London: Cambridge University Press, 1910.) Price 3s.

(2) *The Student's Arithmetic.* By W. M. Baker and A. A. Bourne. Pp. viii+328+1. (London: G. Bell and Sons, Ltd., 1910.) Price 2s. 6d.

(3) *First-Year Mathematics for Secondary Schools.* By Prof. G. W. Myers and others. Third edition. Pp. xii+365. (Chicago, U.S.A.: University of Chicago Press; London: Cambridge University Press, 1909.) Price 4s. net.

(4) *Second-Year Mathematics for Secondary Schools.* By Prof. G. W. Myers and others. Pp. xiv+282. (Chicago, U.S.A.: University of Chicago Press; London: Cambridge University Press, 1910.) Price 6s. net.

(5) *Geometric Exercises for Algebraic Solution. Second-Year Mathematics for Secondary Schools.* By Prof. G. W. Myers and others. Second impression. Pp. ix+71. (Chicago, U.S.A.: University of Chicago Press; London: Cambridge University Press, 1909.) Price 3s. 6d. net.

(1) THE introductory course provided by this textbook includes the solution of triangles, omitting the ambiguous case, applications to the geometry of the triangle and quadrilateral, and easy problems in surveying. Complicated identities are excluded on the ground that they belong to the programme of the specialist rather than the amateur for whose use this is primarily intended. The general character of the book will probably be considered unduly conservative. It fails to take cognisance of the recent movement affecting the teaching of trigonometry. There is scarcely as much numerical work as many teachers will require, and the quality of the problems, which profess to be practical, is distinctly poor. The best feature of the book is the material provided for oral work, which will be found invaluable for class purposes.